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PIEZOELECTRIC DAMPING MATERIAL

[圧電制振材料]

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(57) [Abstract]

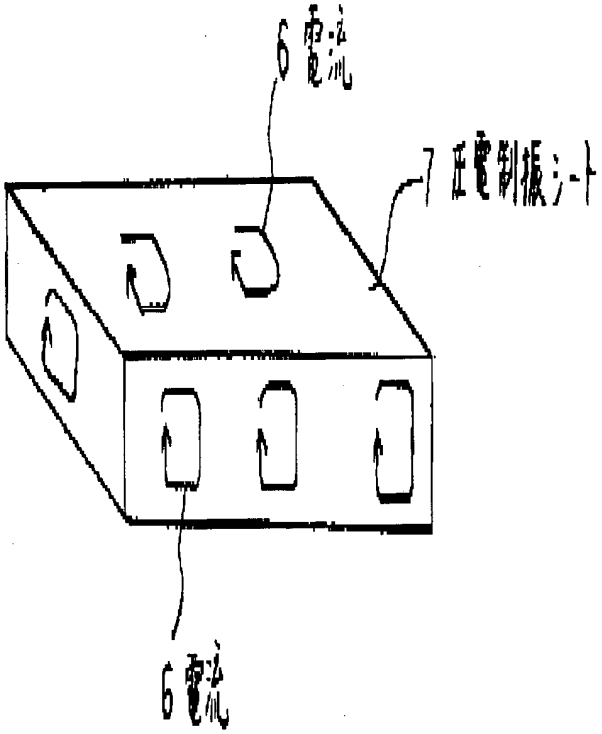
[Problems to be Solved by the Invention]

The invention provides a piezoelectric damping material that is easily adjustable in conductivity to offer an appreciable damping effect.

[Means to Solve the Problems]

Carbon nanotubes as conductive particles, and polyvinylidene fluoride or the like as a piezoelectric polymer are packed at a fixed weight ratio and are subjected to kneading, hot press molding and cold pressing at respective temperatures and pressures to provide a sheetlike molding, which is in turn uniaxially drawn and then impressed with a high electric field for polarization so as to be converted into the piezoelectric damping material.

As a result, electrical energy generated by vibration can flow as a current 6 in an electric resistor formed by the carbon nanotubes distributed inside and on the surface of a piezoelectric damping sheet 7 and be consumed as Joule's heat to damp the vibration energy.



[Claim(s)]

[Claim 1]

A piezoelectric damping material which is characterized in that it comprises a piezoelectric damping material composed of a piezoelectric polymer and a material filled with electrically conductive particles wherein said electrically conductive particles are carbon nanotubes.

[Description of the Invention]

[0001]

[Technological Field of Invention]

The invention relates to a piezoelectric damping material which possesses antivibration property in order reduction and exemption to do vibration which occurs vibration rapidly piezoelectric damping material, which has function which attenuation is done especially, in vehicle, railroad, airplane or other transportation equipment related materials, household appliance and office automation equipment or other electric equipment related materials, construction and building material related materials, etc.

[0002]

[Prior Art]

Until recently, those which utilize polymer elastic material as damping material which is used for above-mentioned member etc, are many, sandwich is done damping steel plate which has been utilized polymer elasticity layer between the, for example, thin steel plate.

In addition, electrically conductive particle like piezoelectric ceramic particle and carbon black or graphite there is also attempt which utilizes resin composite material which is filled as piezoelectric damping material.

With this kind of piezoelectric damping material, when it can add vibration from outside, as for vibrating energy being converted by electrical energy by piezoelectric effect of piezoelectric ceramic particle which amount fabric is done inside resin composite material, it generates alternating current voltage inside same particle.

This alternating current voltage imparting is done in electrical resistance which is formed by electrically conductive particle which amount fabric is done inside same composite material electrical energy is consumed absorbs vibrating energy as finally joule heat.

[0003]

But, as description above electrically conductive particle like carbon black or graphite which is used for piezoelectric damping material, in order with a certain critical amount vicinity to cause cohesion in the polymer matrix, when distance between electrically conductive particle does proximity, electrical conductivity increasing remarkably, is a deficiency that control of electrical conductivity becomes difficult.

In surface of piezoelectric film like, for example, polyvinylidene fluoride (PVDF) as solves this deficiency the coating fabric it does carbon electrode, vapor deposition is done piezoelectric damping film which you use it is proposed Al as piezoelectric damping material of the above-mentioned application.

[0004]

[Problems to be Solved by the Invention]

When as description above piezoelectric damping film you use, as piezoelectric damping material it is necessary to form conducting layer of constant thickness which uniform is done with coating fabric or vapor deposition on necessary surface area of piezoelectric damping film.

For this controlling thickness and vapor deposition method of conducting layer strictly, you must form, there is a problem that cost in order to form conducting layer becomes high.

[0005]

In addition, because conducting layer exists in just surface of piezoelectric damping film, because electrical energy which occurs due to piezoelectric effect is gathered in the conducting layer, as shown in Figure 3, connecting outside resistance 13 to conducting layer 12 of the piezoelectric damping film 11, it is necessary to consume to remove electrical energy as current 14 and as joule heat, Because of that there is a problem that equipment itself becomes complicated.

As for this invention, considering to this kind of situation, being something which it is possible, outside resistance it does not need, piezoelectric damping material whose adjustment of electrical conductivity which is necessary in order to obtain the necessary damping effect is easy it is offered it makes objective.

[0006]

[Means to Solve the Problems]

In order to achieve above-mentioned objective, as for piezoelectric damping material of the this invention, electrically conductive particle is carbon nanotube in piezoelectric damping material which designates piezoelectric polymer and electrically conductive particle as filler, and it is something which is made feature.

Piezoelectric damping material of this invention outside resistance does not need with above-mentioned constitution, can offer piezoelectric damping material whose adjustment of electrical conductivity in order in addition to obtain satisfactory damping effect is easy.

[0007]

[Embodiment of the Invention]

Piezoelectric damping material is explained in detail with this invention.

It is something where piezoelectric damping material of this invention designates piezoelectricity polymer and carbon nanotube which are explained on description below as filler, the melt mixing after doing, heating and pressurizing this filler in fixed condition, molding doing in predetermined shape, becomes.

[0008]

As aforementioned piezoelectric polymer, you can use polyvinylidene fluoride, polyvinylidene fluoride + trifluoroethylene copolymer, vinylidene fluoride + tetrafluoroethylene copolymer.

In addition, it can form aforementioned carbon nanotube, making use of the flow-through type fixed bed reactor which is shown in Figure 1.

As for this flow-through type fixed bed reactor, surrounding reaction tube 1 of quartz which becomes internal diameter 8 cm, length 30 cm and, this, as it is constituted from electric furnace 4 in order to heat and valve 5 in order to discharge reactive gas inside reaction tube 1, in center vicinity of aforementioned reaction tube 1 glass wool 3 has been filled in catalyst 2 and both sides.

[0009]

After in aforementioned reaction tube 1 each at a time 50% Ni and the catalyst 300g which consists of SiO_2 it is filled with wt%, supplies H_2 gas of flow 2 liter/min, 1 hr reducing with 500°C, with volume ratio 2: H_2 gas of 1 and mixed gas which consists of CO_2 gas are introduced with flow 7.5 liter/min, with 500°C 4 hr reactions later and inside same reaction tube 1 are substituted with nitrogen gas and carbon nanotube is formed by cooling to room temperature.

In addition, you can use carbon nanotube which is formed even with carbon nanotube formation method of arc discharge method, laser evaporation method, chemical vapor deposition method, thermal cracking method or other public knowledge as electrically conductive particle of this piezoelectric damping material.

[0010]

As for content of carbon nanotube in this piezoelectric damping material it is not necessary to be fixed, it can consider size of vibration which reduction and exemption you want to do, and site of vibration and size, thickness of molded article in order for optimum surface resistance to be acquired, it can decide content of carbon nanotube.

As for namely, carbon nanotube those which become critical amount where electrical conductivity changes suddenly unlike electrically conductive particle like carbon black or graphite, cannot exist, can select appropriately according to revelation of function which adjusts content of aforementioned carbon nanotube in value of option to be possible, makes objective.

[0011]

Molding is possible piezoelectric damping material of this invention to various shape, but when with this working example it makes sheet, being attached, you explain.

As electrically conductive particle carbon nanotube which is formed with above-mentioned method, in addition, poly vinylidene fluoride is used as piezoelectric polymer.

Weight ratio 35 : 65 of carbon nanotube and piezoelectricity polymer are used in and after kneading this with 190°C, sheet of thickness 0.2 mm is acquired with 210°C with 30 Kfg/cm^2 4 min heated press after forming, by 3 min cooling

press doing with 30 kgf/cm^2.

[0012]

Furthermore, in order to designate above-mentioned sheet as the piezoelectric damping material, next kind of polarization is done.

Above-mentioned sheet with uniaxial stretching machine with 150°C in 3 times the uniaxial drawing after doing, electric field of 100 MV/m is applied with 25°C and per 150 X 150 (mm^2) surface resistance of 2 X 10^3 Ω can be acquired by the polarization doing.

With piezoelectric damping material which is produced by this method, as electrical energy which occurs due to vibration shows in Figure 2, it is let flow by the electrical resistance which is formed with carbon nanotube which amount fabric is done in internal and surface of piezoelectric damping sheet 7 as current 6, it is consumed as joule heat.

[0013]

Test specimen of 3 X 40 (mm^2) is cut off from above-mentioned piezoelectric damping material, with dynamic thermomechanical analyzer result which vibration control performance evaluation is done has damping function in low frequency domain of 20 - 80 Hz, it was verified.

Because this changes surface resistance by changing content of the carbon nanotube and is possible, possibility which can make control of fine vibration control performance simple by adjusting this content, has been shown.

[0014]

Piezoelectric damping material of this invention used carbon nanotube for electrically conductive particle which is filled in piezoelectricity polymer, adjusted filled amount and tried to be able possess antivibration property which is suited for application by kneading, drawing, heating, it pressurizes and polarization or other processing, we have made feature, specification value with aforementioned processing is not something which is limited in Working Example, It is possible to various specification value to modify in order to obtain antivibration property which responds to application.

In addition, piezoelectric polymer which is used for piezoelectric damping material is not something which is limited in Working Example, you can use also other copolymer such as vinylidene cyanide and copolymer of vinyl acetate where piezoelectric characteristic of thickness direction is superior in comparison with, for example, PVDF.

[0015]

[Effects of the Invention]

Because control of electrical conductivity in order to obtain satisfactory damping effect is easy, be able to offer preferred piezoelectric damping molded article to production with industry scale, you can use piezoelectric damping material of this invention, effectively to control and the attenuation of vibration and noise in relationship of automobile, audio, construction and building.

In addition, as sucking/absorbing sound blocking structure which is superior due to especially combining with super bond and glass wool or other porous fiber material you can use.

Furthermore, consuming electrical energy which occurs with piezoelectric damping sheet with the closed circuit which is formed with carbon nanotube, because it can convert to the joule heat, outside resistance it can make unnecessary, can make equipment configuration simple.

[Brief Explanation of the Drawing(s)]

[Figure 1]

It is a configuration diagram of flow-through type fixed bed reactor which produces carbon nanotube which relates to this invention.

[Figure 2]

It is a figure which shows flow path of current which occurs with electrical energy inside piezoelectric damping material of this invention.

[Figure 3]

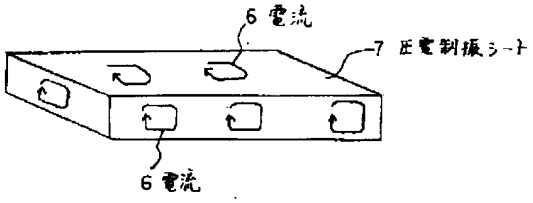
It is a figure which shows flow path of current which occurs with electrical energy inside conventional piezoelectric damping film.

[Explanation of Symbols in Drawings]

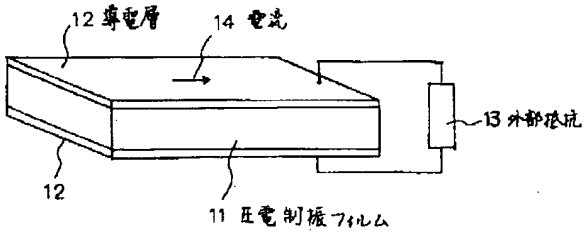
reaction tube	1
piezoelectric damping film	11
conducting layer	12
outside resistance	13
current	14
catalyst	2
glass wool	3
electric furnace	4
valve	5
current	6
piezoelectric damping sheet	7

Drawings

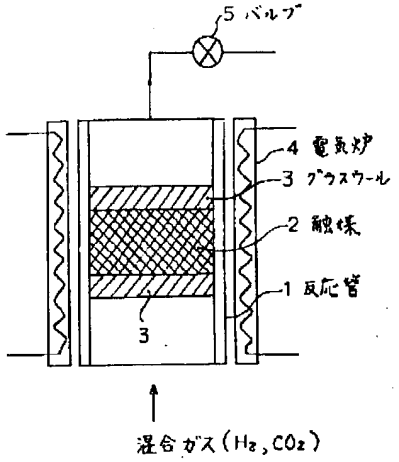
[Figure 2]



[Figure 3]


12 導電層
14 電流
13 外部抵抗
12
11 圧電制振フィルム

[Figure 1]


5 バルブ
4 電気炉
3 グラスウール
2 触媒
1 反応管
3
混合ガス(H2, CO2)